CHAPTER 01

Introduction to Information Technology

Introduction

Computers have now become an integral part of our daily life. People use computers for a variety of reasons and purposes. Be it education, business, entertainment, communication, government service or transportation, computers are inevitable today. Information Technology (IT) is the use of computers to store, retrieve, process and exchange all kinds of digital data and information. Information technology involves a combination of hardware and software that is used to perform the essential tasks that people need and use on everyday basis. Since we live in the "world of information", information technology has become a part of our daily lives. Information is not originated, but generated from data. So let us go through the basic concepts of data processing, the role of computers and their evolution through various eras.

Learning outcomes

After the completion of this chapter, you will be able to

- distinguish between data and information.
- cite examples for data and information.
- identify the stages involved in data processing.
- define computer as a data processor and list the characteristics of computers.
- categorize different generations of computers based on technological advancements.
- explain the functional units of a computer.

1.1 Data and Information

Many of us are familiar with the terms data and information. We often use these terms interchangeably in our daily life. But there exists fundamental difference between these two.

Data denotes raw facts and figures such as numbers, words, amount, quantity etc. that can be processed or manipulated. For example, "Ardra", 18, 1986, 48, 21/02/2002, 6 January 2022, 11:25:38 etc. are referred to as data. These raw facts and figures do not give a clear idea about what they really mean, since there is no indication or reference attached to them. So anyone can arrive at any conclusion or inference, which may vary from person to person. These inferences may be deviating from the actual interpretation. To interpret each of these data properly, appropriate indicators or labels are to be linked with them. In this case, if we present them with suitable labels as shown in the box, it becomes the information about a person.

Name	:	*Ardra*
Age	:	*18 Years*
Date of birth	:	*21/02/2002*
Admission No.	:	*1986*
Date of Admn.	:	*6th Jan 2022*
Marks	:	*48*

Information is the meaningful and processed form of data. Mark list of a student, rank list for the admission of a course, railway reservation chart, curriculum vita of a person etc. are examples of information.

Data given to the computer may be of different types. They include number, text, date, time, image, audio and video. Number type data includes both integer numbers and floating point numbers. -25, 0, 1276, 3.14, $1.7x10^{-5}$ are some examples. Text data is constituted by the alphabets of human languages like English, Malayalam etc. They are also known as string type data. Text data may even be a combination of letters and digits. The date type data may take a standard form like DD-MM-YYYY, DD/MONTH/YYYY. Similarly time data may be of the form HH:MM:SS. The other three types of data named image, audio and video are represented by various formats and hence unstructured.

1.2 Data processing

Usually raw data is unable to be used directly. They need to undergo some sort of processes. As a result of the process, we get information which is useful for decision making and problem solving. The term data processing refers to the operations or activities performed on data to generate information. So we can say that information is the result of data processing. As shown in Figure 1.1, data is supplied for processing and information is obtained after processing.

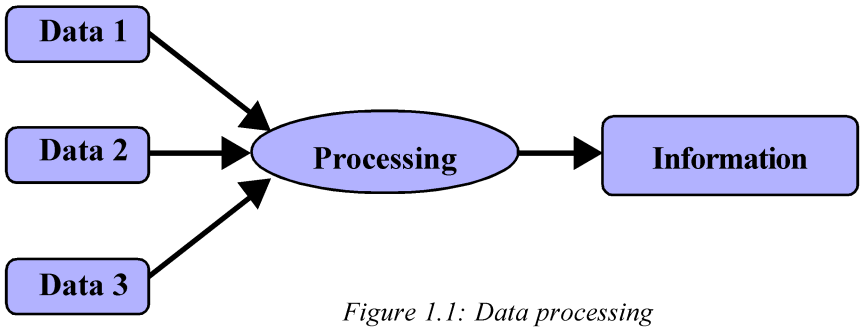


Figure 1.1: Data processing

Data processing proceeds through the following stages:

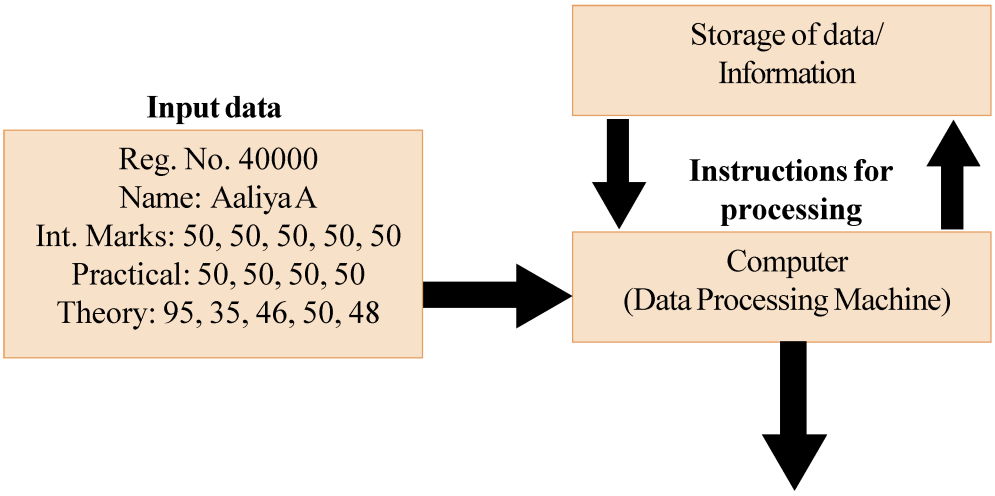
(a) **Input of data:** Feeding data into the computer for processing is known as input. Sometimes, we may enter the data directly into the computer (online data entry) and in some other cases data is collected through prescribed forms and then it is entered.

(b) **Storage of data:** In many cases, the amount of data given to the computers will be large. Besides, the data entry (input) may not be completed in a single session or a day. The processing can start only after the entire data is so stored. The input data is usually stored in any storage device of computers before it is being processed. The information obtained as a result of processing may also need to be stored. Both these stored data and information can be used in future for various purposes.

(c) **Processing of data:** Various operations like calculation, classification, comparison, sorting, filtering, summarising etc. are carried out as a part of processing. For example, as a part of admission procedure of a course, the institution has to prepare a rank list based on total marks of students in the qualifying examination. Separate rank lists for reservation quota are also prepared by filtering the data.

(d) **Output of information:** The information obtained after processing will be available in this stage. Output stage should provide the information in such a form that the beneficiary should be able to take decision or solve a problem.

Now let us see in detail, the various procedures involved in the different stages of data processing through the following example. Preparation of mark lists of students after the DCA examination. SCOLE Kerala (the authority of DCA course) collects the internal marks of students from various study centres and the marks of practical and theory examinations from examination centres. These data are given to the computer for processing. The computer processes the data according to a given set of instructions. As a result we get the mark lists as output. Figure 1.2 shows the data processing involved in the preparation of mark list. The input data mainly includes the register number and marks of all the candidates in the examination, though the figure shows the data of only one. The entire data will be input into the computer ensuring its validity. The input data will be stored systematically and safely in suitable structure. After the completion of data entry and verification, programs will be executed to process them to generate individual mark list. Different types of reports may be created in addition to the mark lists. The output will be in a suitable format such that there is no ambiguity in the information provided.



Name of Candidate : **AALIYA A**
Register Number : **40000**
Month & Year : **July 2021**

Subject Code	Subjects		Maximum Marks	Minimum Marks	Marks Awarded	Result
DC01	Informatics	Theory	100	40	95	P
		Internal	50	20	50	P
DC02	MS Office and Internet	Theory	50	40	35	P
		Practical	50		50	
		Internal	50	20	50	P
DC03	Linux and Open Office	Theory	50	40	46	P
		Practical	50		50	
		Internal	50	20	50	P
DC04	PC Techniques	Theory	50	40	50	P
		Practical	50		50	
		Internal	50	20	50	P
DC05	Malayalam Computing	Theory	50	40	48	P
		Practical	50		50	
		Internal	50	20	50	P
Total			750	300	724	Pass

Minimum marks for pass in Theory and Practical is 40% each

Figure 1.2: Illustration of a data processing

1.3 Computer - as a data processor

The activities involved in different stages of data processing have been discussed in the previous section. In earlier days, data processing activities were carried out by humans, often with the help of calculators or similar tools. In some cases, when the quantity of data became huge, there happened delay in getting information and inaccuracy in result in some

cases. But we always need accurate, comprehensive, reliable and timely information. Thus computer has emerged as a data processing machine having a vital role in this context.

The word "computer" comes from "compute" which means "to calculate". This doesn't mean that a computer is just like a calculator or any other computing device which performs mathematical operations at high speed. The capabilities of a computer are beyond that of a calculating device. It can be defined as an electronic machine designed to accept data and instructions, perform arithmetic and logical operations on the data according to a set of instructions, and output the results or information.

1.3.1Characteristics of computers

There are certain characteristics which make the computer widely accepted as an efficient data processing machine which are explained below.

- S**peed:** A computer can perform millions of operations in a second or in a fraction of second. It can do in a minute, as much work as a man do taking months and years.
- **Accuracy:** A computer can perform arithmetic operations with a very high degree of accuracy. By accuracy, we mean fewer errors in the output and precision with which computations are performed.
- **Diligence:** Since computer is a machine, it can operate for long hours untiringly. Unlike human beings, it will not express any kind of tiredness or hesitate to execute the same job repeatedly. Hence computers are best suited for routine jobs.
- **Versatility:** Computer can be used to perform many different kinds of processing tasks. It is a general purpose data processing machine.
- **Huge memory:** Computer has enormous memory capacity. Huge volume of data can be stored in its memory for processing. The storage capacity can also be increased as per requirement.

  Though computers have above mentioned characteristies as advantages they have some limitations also.

- **Lack of IQ:** Many people think that computer has super human capabilities. However this is not true. A computer does not have natural intelligence as humans have.
- **Lack of decision making power:** Computer cannot decide on its own and it does not possess intuitive capabilities like human beings.The computer gives correct results only if the data and instructions given are correct. The term "Garbage In Garbage Out" (GIGO) is used to mean this feature. That is, if a wrong input is given to the computer, it will give a wrong output.

1.4 Generations of computers

During the period from 3000 BC to 1450 AD, human beings started communicating and sharing information with the aid of simple drawings and later through writings. The introduction of numbers led to the invention of Abacus, the first computing machine. The evolution of computers started from the 16th century, resulting in today's modern machines. It is distinguished into five generations of computers from the first programmable computer (ENIAC - Electronic Numerical Integrator and Calculator) to the one based on artificial intelligence. Each generation of computers is characterized by a major technological development that fundamentally changed the way computer operate, resulting smaller, cheaper, more powerful, more efficient and reliable computing devices.The technology, the presence of Operating System (the essential software for computers), language through which instructions are given and the approximate time period are included to distinguish the generations.

Human beings started communicating and sharing information with the aid of voice and simple drawings. Later, at a period about 3200 BC, they started writing to communicate with each other. The introduction of numbers led to the invention of Abacus, the first computing machine in the period 2700-2300 BC. Researches and developments in the field of Science and Mathematics led to the invention of different kinds of calculating or computing machines which led to the evolution of computers. During this evolution, many technological and fundamental changes have been incorporated in the functioning of computers. This resulted in the availability of a variety of smaller, cheaper, more powerful, more efficient and reliable computing devices varying from the first programmable computer ENIAC (Electronic Numerical Integrator and Calculator) to the smart devices based on Artificial Intelligence. These computers are classified in terms of "generations of computers" as each innovation persisted over a period of time.

The first generation computers (1940 - 1956) used vacuum tubes as the major component and machine language for user's instructions. The second generation computers (1956 - 1964) used transistors as the core component, which made the computers smaller in size, larger in storage capacity and better in performance. Assembly language and high level languages like FORTRAN and COBOL were used to write programs for these computers. The third generation computers (1964 - 1971) adopted Integrated Circuit (IC) chips to make processors and other components. Here high level languages were widely used to develop programs. Micro processors have been used as CPU in the fourth generation computers since 1971. This paved the foundation for large scale production of computers. Handy and portable devices were developed for input and output operations. Computer itself has become portable and a variety of programming languages like Pascal, C, C++, Java, Python, 4GL etc. have been evolved resulting into different programming approaches.

Artificial Intelligence has become the main thrust in fifth generation computers - computers of the present and future. Enhancement of the computational capabilities and the areas of applications are still under rigorous research.

Info Box

- *Abacus is considered as the first computing device.*
- *John Napier developed Napier's bones in 1617 AD, by which multiplication could be performed.*
- *Blaise Pascal invented 'Pascaline' in 1642.*
- *In 1673, Gottfried Wilhelm von Leibniz designed a calculating machine named Step Reckoner.*
- *Charles Babbage invented Difference Engine in 1822 and designed Analytical Engine in 1833. Analytical Engine has many features found in modern computer and hence Babbage is known as the Father of computers.*
- *Agusta Ada King had written instructions for Babbage's machine and she is known as the first programmer.*
- *In 1944, Howard Aiken, in collaboration with engineers at IBM constructed an automatic electromechanical computer Mark - I.*
- *The first general purpose programmable electronic computer, Electronic Numerical Integrator and Calculator (ENIAC) was developed during the first generation by J. Prseper Eckert and John V. Mauchly. In 1952 they developed the first commercially successful computer Universal Automatic Computer (UNIVAC)*
- *John Bardeen, Walter Brattain and William Shockley developed transistors at Bell Laboratories.*
- *High level languages like FORTRAN and COBOL were developed during the second generation.*
- *Jack Kilby developed Integrated Circuit (IC) chip.*

1.5 Functional units of a computer

Figure 1.3: John Von Neumann

Even though computers differ in size, shape, performance and cost over the years, the basic organisation of a computer is the same. It is based on a model proposed by John Von Neumann, a mathematician and a computer scientist. It consists of some functional units namely Input Unit, Central Processing Unit (CPU), Storage Unit and Output Unit. Each of these units is assigned to perform a particular task. Let us discuss the functions of these units. Figure 1.4 shows the basic functional units of a computer.

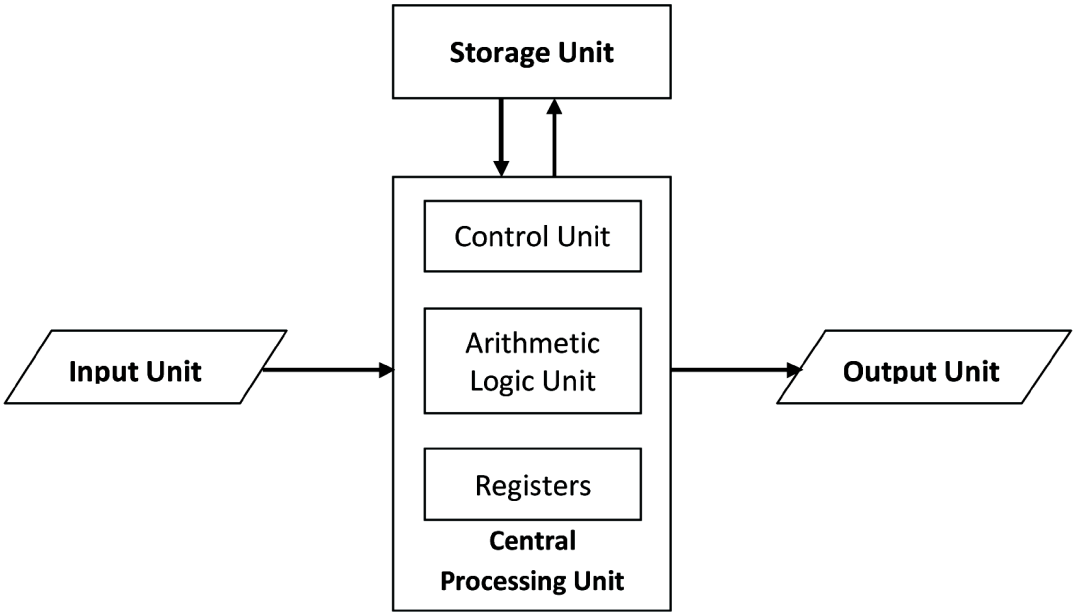


Figure 1.4: Functional units of a computer

(i) Input unit

The data and the instructions for their processing are entered into the computer through the input unit. They are stored in the memory (storage unit). The data may be in different forms like number, text, image, audio, video, etc. Nowadays, graphics user interface (GUI) is provided to input the data, ensuring proper format and validity checks. A variety of devices are available to input the data depending on its nature. Keyboard, mouse, scanner, microphone, digital camera, etc. are some commonly used input devices.

(ii) Central Processing Unit (CPU)

The CPU is the brain of the computer. In a computer system, all major computations and comparisons are made inside the CPU. It is also responsible for activating and controlling the operations of other units of the computer. The functions of CPU are performed by three components - Arithmetic Logic Unit (ALU), Control Unit (CU) and registers.

a. **Arithmetic Logic Unit (ALU):** The actual operations specified in the instructions are carried out in the Arithmetic Logic Unit (ALU). It performs arithmetic operations such as addition, subtraction, multiplication and division; and logical operations such as comparisons and decision making.

b. **Control Unit (CU):** Each of the functional units has its own function, but none of these will perform the function until it is asked to. This task is assigned to the control unit. It invokes the other units to take charge of the operation they are associated with. It is like the central nervous system that manages and co-ordinates all other units of the computer. It obtains instructions from the program stored in the memory, interprets the operation and issues signals to the unit concerned in the system to execute them.

c. **Registers:** These are temporary storage elements that facilitate the functions of CPU. There are a variety of registers; each designated to store unique items like data, instruction, memory address, results, etc.

(iii) Storage unit

The data and instructions entered in the computer through input unit are stored inside the computer before actual processing starts. Similarly, the information or results produced after processing are also stored inside the computer, before transferring to the output unit. Moreover, the intermediate results, if any, must also be stored for further processing. The storage unit of a computer serves all these purposes. The storage unit comprises of two types as detailed below:

(a) Primary storage: It is also known as main memory. It is again divided into two - Random Access Memory (RAM) and Read Only Memory (ROM). RAM holds instructions, data and intermediate results of processing. It also holds the recently produced results of the job done by the computer. ROM contains instructions for the start up procedure of the computer. The Central Processing Unit can directly access the main memory at a very high speed. To enhance the speed of access, a faster storage component named cache memory is placed in between RAM and CPU. Both RAM and cache are costly and have limited storage capacity.

(b) Secondary storage: It is also known as auxiliary storage and it takes care of the limitations of primary storage. It has huge storage capacity and the storage is permanent. Usually we store data, programs and information in the secondary storage, but we have to give instruction explicitly for this. Hard disk, CDs, DVDs, memory sticks, etc. are some examples of secondary stroage devices.

(iv) Output unit

The information obtained after data processing is supplied to the outside world through the output unit in a human-readable form. While providing the output, there will be instructions to provide the same in suitable formats and media. This is to enhance the clarity and understandability of the results or information. Monitor and printer are the commonly used output devices.

SUMMARY

In this chapter, we have discussed the basic concepts of data processing and seen computer as a data processing machine. Data denotes raw facts and figures, whereas information is the processed form of data. The conversion of data into information is known as data processing. In this process, the input data is stored and various operations are performed on it to produce information as output. Computer is an electronic data processing machine which can give accurate results after performing millions of operations in seconds. Today's computers are evolved through five generations and the performance has been enhanced drastically with the help of advancements in technologies. Still, the computers follow John Von Neumann's architecture which includes input unit, central processing unit (consisting of arithmetic logic unit and control unit), storage unit and output unit as the functional components.

EVALUATION

Objective type questions

1. Processed data is known as.....
2. Which computer generation used microprocessor as CPU?

   (a) First generation (b) Second generation

   (c) Third generation (d) Fourth generation
3. Second generation of computers used as the processor.
4. GIGO stands for .
5. Which of the following memory is a part of CPU?

   (a) RAM (b) ROM

   (c) Cache (d) Registers

Very short answer type questions

6. Distinguish between data and information.
7. Define computer.
8. What are the limitations of computers?
9. List down the activities involved in the process phase of data processing.

Short answer type questions

10. How is storage unit classified? Explain.
11. Explain the components of CPU.

Descriptive type questions

12. What is data processing? Explain different stages of data processing.
13. Explain the advantages of computers.
14. Briefly describe the concept "generations of computers".

Essays

15. Briefly describe the functional units of a computer with the help of a block diagram.